भारतीय मानक **IS 3025 (Part 23) : 2023**

Indian Standard

जल एवं अपशिष्ट जल के नमूने लेने तथा परीक्षण (भौतिक एवं रसायन) की पद्धतियाँ

भाग 23 क्षारीयता

(दूसरा पुनरीक्षण)

Methods of Sampling and Test (Physical and Chemical) for Water and Wastewater

Part 23 Alkalinity

(Second Revision)

ICS 13.060.50

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July 2023 **Price Group 8**

Water Quality Sectional Committee, CHD 36

FOREWORD

This Indian Standard (Part 23) (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Water Quality Sectional Committee had been approved by the Chemical Division Council.

Alkalinity of water or wastewater is its quantitative capacity to react with a strong acid to a designated *p*H. Alkalinity is significant in many uses and treatments of natural and wastewaters, alkalinity measurements are used in the interpretation and control of water and wastewater treatment processes.

The committee responsible for the formulation of IS 3025 : 1964 ‘Methods of sampling and test (physical and chemical) for water used in industry’ had decided to revise the standard and publish it in separate parts. This standard is one of the different parts under IS 3025 series of standards and supersede **13** and **14** of IS 3025. The first revision was published in 1986.

In this second revision the following modification have been incorporated:

a) Amendment No. 1 September 2000 and the Amendment No. 2 April 2006 have been incorporated;

b) References, ICS No. have been updated; and

c) Other editorial changes have been done to bring the standard in the latest style and format of Indian Standards.

In the preparation of this standard, considerable assistance has been derived from the method no. 2320 B of — Standard methods for the examination of water and wastewater, published by the American Public Health Association, Washington, USA, 23nd Edition, 2017.

The composition of the committee responsible for the formulation of this standard is listed in Annex A.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

Indian Standard

METHODS OF SAMPLING AND TEST (PHYSICAL AND CHEMICAL) FOR WATER AND WASTEWATER

Part 23 Alkalinity

(Second Revision)

1 SCOPE

This standard (Part 23) prescribes the potentiometric and indicator methods for determination of alkalinity. These methods are applicable to determine alkalinity in water and wastewater in the range of 0.50 mg/l to 500 mg/l alkalinity as $CaCO_3$. The upper range may be extended by dilution of the original sample.

2 REFERENCES

The standards listed below contain provisions which through reference in this text constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

IS No.	*Title*
IS 3025 (Part 21) : 2009	Methods of sampling and test (physical and chemical) for water and wastewater: Part 21 Hardness (*second revision)*
IS 7022 (Part 1) : 1973	Glossary of terms relating to water, sewage and industrial effluents: Part 1
IS 7022 (Part 2) : 1979	Glossary of terms relating to water, sewage and industrial effluents: Part 2
IS 17614 (Part 1) : 2021	Water Quality – Sampling : Part 1 Guidance on the design of sampling programmes and sampling techniques
IS 17614 (Part 3) : 2021	Water Quality – Sampling : Part 3 Preservation and handling of water samples

3 TERMINOLOGY

For the purpose of this standard, definitions given in IS 7022 (Part 1) and IS 7022 (Part 2) shall apply.

4 SAMPLING AND STORAGE

Sampling and sample preservation shall be done as prescribed in IS 17614 (Part 1) and IS 17614 (Part 3).

5 PRINCIPLE AND THEORY

Alkalinity of water is the capacity of that water to accept protons. It may be defined as the quantitative capacity of an aqueous medium to react with hydrogen ions to *p*H 8.3 (phenolphthalein alkalinity) and then to *p*H 4.5 (total alkalinity or methyl orange alkalinity). The equation in its simplest form is as follows:

$$CO_3 + H^+ \longrightarrow HCO_3 \ (pH\ 8.3)$$

From *p*H 8.3 to 4.5, the following reaction may occur:

$$HCO_3 + H^+ \longrightarrow H_2CO_3$$

6 INTERFERENCES

Free available residual chlorine markedly affects the indicator colour response. The addition of minimal volumes of sodium thiosulphate eliminates this interference. Substances such as salt of weak organic or inorganic acids present in large amount may interfere. Oils and greases may also interfere by coating the electrode. Coloured or turbid samples may interfere in end point. Analyse such samples by potentiometric titration.

7 SAMPLE PREPARATION

The sample aliquot used for analysis should be either free from turbidity or should be allowed to settle prior to analysis.

8 APPARATUS

8.1 *p*H Meter

8.2 Burette, 50 ml capacity.

8.3 Pipets, 10 ml capacity.

8.4 Beaker, 100 ml.

8.5 Volumetric flask, 100, 200 ml.

8.6 Magnetic Stirrer Assembly

9 REAGENTS

9.1 Distilled Water

Distilled water used should have *p*H not less than 6.0. If the water has *p*H less than 6.0, it shall be freshly boiled for 15 min and cooled to room temperature. Deionized water may be used provided that it has a conductance of less than 2 *μ*s/cm and a *p*H more than 6.0.

9.2 Sodium Carbonate Solution (Na_2CO_3), 0.05 N (as primary standard for standardization of sulphuric acid)

Dry 2 g to 4 g of Na_2CO_3 at 250 °C for 4 h and cool in a desiccator. Weight 1.25 g ± 0.2 g and transfer to 500 ml volumetric flask, fill the flask with 100 ml to 200 ml of distilled water to dissolve the content. Finally make up the volume of distilled water up to the mark. Do not keep solution longer than 1 week.

9.3 Sulphuric Acid

Dilute 5.6 ml of concentrated sulphuric acid (relative density 1.84) to 1 litre with distilled water.

9.3 Standard Solution of Sulphuric Acid, 0.02 N

9.4 Phenolphthalein Indicator

Dissolve 0.5 g of phenolphthalein in 100 ml, 1 : 1 (v/v), alcohol water mixture.

9.5 Mixed Indicator Solution

Dissolve 0.02 g methyl red and 0.01 g bromocresol green in 100 ml, 95 percent ethyl or isopropyl alcohol.

10 Procedure

10.1 Indicator Method

Pipette 20 ml or a suitable aliquot of sample into 100 ml beaker. If the *p*H of the sample is over 8.3, then add 2 to 3 drops of phenolphthalein indicator and titrate with standard sulphuric acid solution till the pink colour observed by indicator just disappears (equivalence of *p*H 8.3). Record the volume of standard sulphuric acid solution used. Add 2 to 3 drops of mixed indicator to the solution in which the phenolphthalein alkalinity has been determined. Titrate with the standard acid to light pink colour (equivalence of *p*H 3.7). Record the volume of standard acid used after phenolphthalein alkalinity.

10.2 Potentiometer Method

Pipette 20 ml or a suitable aliquot of sample into a 100 ml beaker and titrate with standard sulphuric acid to *p*H 8.3 and then to *p*H 3.7, using a potentiometer. No indicator is required.

11 Calculation

11.1 Calculate alkalinity in the sample as follows:

Phenolphthalein alkalinity (as mg/l of $CaCO_3$)

$$= \frac{A \times \mathrm{N} \times 50\,000}{V}$$

Phenolphthalein alkalinity (as mg/l of HCO_3)

$$= \frac{A \times \mathrm{N} \times 50\,000 \times 0.6}{V}$$

Total alkalinity (as mg/l $CaCO_3$)

$$= \frac{(A+B) \times \mathrm{N} \times 50\,000}{V}$$

Total alkalinity (as mg/l HCO_3)

$$= \frac{(A+B) \times \mathrm{N} \times 50\,000 \text{ x } 0.6}{V}$$

where

A = volume of standard sulphuric acid used to titrate to *p*H 8.3, in ml;
B = volume of standard sulphuric acid used to titrate from *p*H 8.3 to *p*H 3.7, in ml;
N = normality of acid used; and
V = volume of sample taken for test, in ml.

11.2 Calculate caustic alkalinity in the sample as shown in Table 1.

11.3 Calculate Excess alkalinity as given below and express the result to the nearest 5 mg/l:

Excess alkalinity (as Na_2CO_3), mg/l

= 1.06 (Total alkalinity (as CaCO3, mg/l) – Total hardness (as $CaCO_3$, mg/l)

Total hardness shall be determined as per IS 3025 (Part 21).

Table 1 Calculation of Different types of Alkalinity from Total Alkalinity (1) and Alkalinity for Phenolphthalein (P)

(*Clause* 11.2)

Sl No. (1)	**Values of P and T** (2)	**Hydroxide Alkalinity** (3)	**Carbonate Alkalinity** (4)	**Bicarbonate Alkalinity** (5)
i)	P = 0	0	0	T
ii)	P < ½ T	0	2P	T-2P
iii)	P = ½ T	0	2P	0
iv)	P > ½ T	2P - T	2(T-P)	0
v)	P = T	T	0	0

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Water Quality Sectional Committee, CHD 36

Organization	*Representative(s)*
Chief Scientist, EPTRI, Hyderabad	SHRI N. RAVEENDHAR **(*Chairperson*)**
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Central Institute of Mining and Fuel Research, Dhanbad	DR (SHRIMATI) BABLY PRASAD DR ABHAY KUMAR SINGH (*Alternate*)
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Confederation of Indian Industry, New Delhi	DR KAPIL K. NARULA DR SIPIKA CHAUHAN (*Alternate*)
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Maharashtra State Pollution Control Board, Mumbai	Dr V. R. Thakur Shri S. C. Kollur (*Alternate*)
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Ministry of Jal Shakti Department of Drinking Water and Sanitation	Shri D. A. Rajasekhar Shri Sumit Priyadarshi (*Alternate*)
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